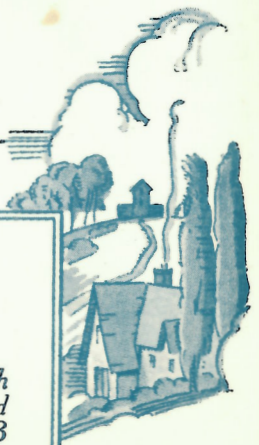
LONDON COUNTY COUNCIL TRAMWAYS



The PULLMAN REVIEW

Issued in connection with Efficiency Meetings and Essay Competition 1932-33

50p

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PUBLISHER'S NOTE

There is much continuing interest in LCC No.1, there are very few clearly illustrated expositions of the conduit system, and very little mention of ticket handling and printing methods. All this, combined with a review of the LCC tramway system at its latest and best, is contained in this LCC booklet of 44 years ago, and available now in wider circles in the form of this facsimile reprint.

The publishers are appreciative of the generous permission, vice M.F.Levey, Publicity Officer, of London Transport to undertake the reprint. It must be stressed that the copyright is still entirely with London Transport.

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LONDON COUNTY COUNCIL TRAMWAYS

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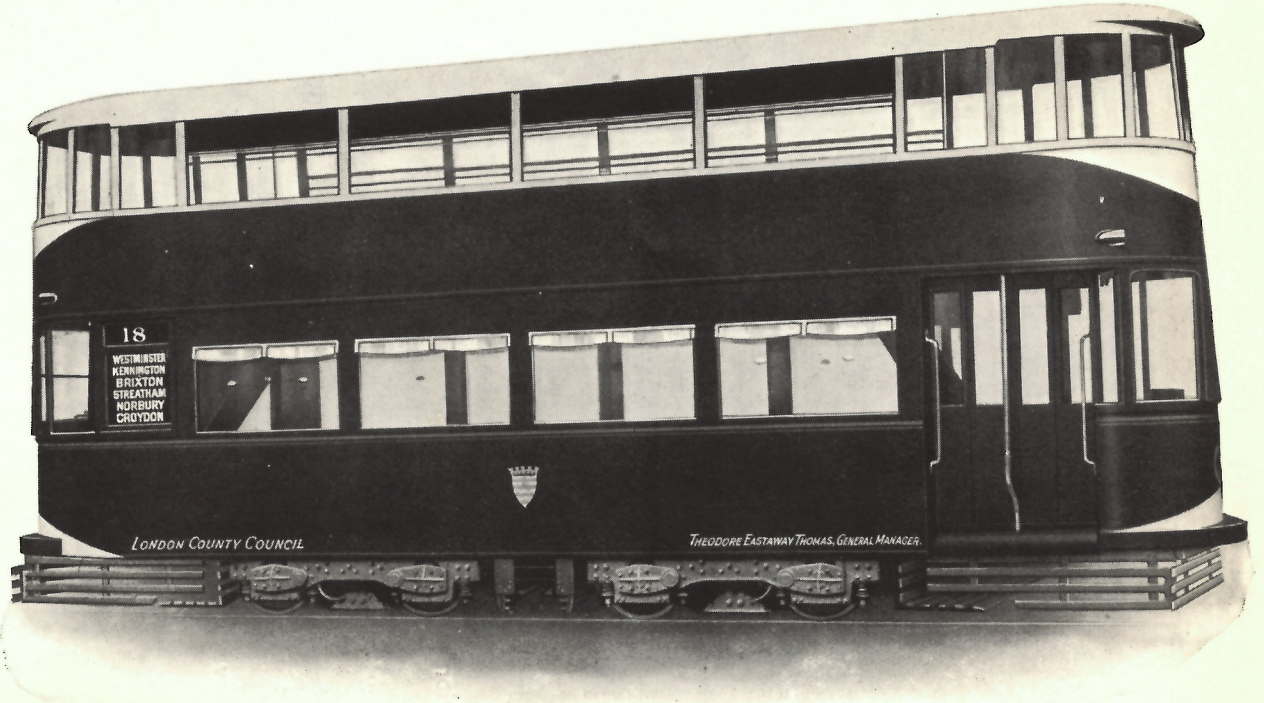
Published May, 1932



THE TRAMCAR OF 1932

It is fully described and further illustrated on pages 18 to 21

TRAFFIC

TRANSPORTING 800,000 PEOPLE IN FOUR HOURS

LONDON County Council Tramways own, maintain and operate 158 miles of route and in addition maintain and operate 9 miles in the area of an adjoining authority, Leyton Corporation. Of the L.C.C 's fleet of 1712 cars 92½ per cent. are available for daily service.

Through-running.—The cars are not confined to the county of London. By through-running agreements they cross the county boundary and run over the lines of five other local authorities and of three companies in the Underground group. Under these arrangements 32 through services operate over nearly 98 miles of tramway outside the county.

Passengers and Car Mileage.—700 million passengers are carried in a year, one in seven at workman fares. Car miles number 70 millions a year, a car travelling, on the average, 132 miles a day. Averaged over the whole system the density is equivalent to a 1¼ minutes service in the rush hours and to a 2 minutes service at other times.

The rush-hour service is very heavy compared with the rest of the day: it is greater than the midday service, for example, by nearly 45 per cent. No fewer than 800,000 passengers are carried within about four

HOW TRAFFIC DELAYS ARE MINIMIZED

From one of more than 400 telephone boxes beside the tramway track a regulator calls up "Control," the invisible finger in tramway operation

See the page opposite

L.N.A. Photos

hours of the day, namely from 7 to 9 a.m. and 5 to 7 p.m. Along Victoria Embankment, nearly a mile in length from Westminster Bridge to Blackfriars Bridge, 175 cars an hour run in each direction. They convey passengers at the rate of nearly 30,000 an hour. At the busiest junction of the tramways, that at the Elephant & Castle, 450 cars pass in an hour.

Before 8 a.m. daily, on weekdays, cars make 2,000 journeys at workman fares. On nine routes there are all-night services, a feature instituted in the year 1899.

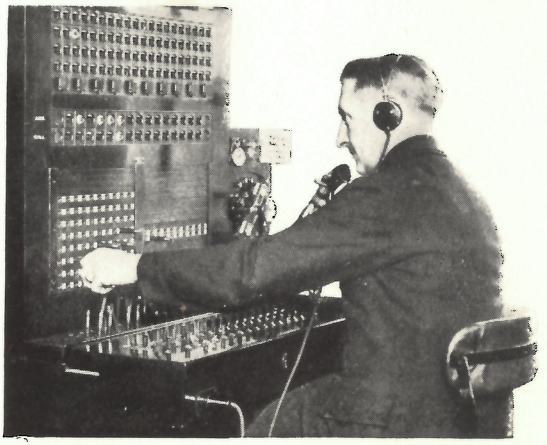
Fares—For the year 1931-32 traffic receipts were £4,140,000 and the average fare paid for a journey was 1.43d. The average fare per mile is ·37d at workman fares, ·55d for ordinary passengers.

Speed averages 9.94 miles an hour including stops, the highest for any large urban area in the kingdom.

A Private Telephone System

The length of traffic delays has been much reduced in two special ways. At half-mile intervals on the route are telephone boxes in direct communication with a central exchange, called Control, and in charge of a traffic official with road experience. It is open day and night to log every happening of importance, issue instructions throughout the system and keep in touch with the management. For instance, if a tramcar service is obstructed, an official or motorman telephones to Control which calls out a breakdown tender equipped with th most up-to-date plant. There are six breakdown tenders equipped with 80 h.p. engines, 5-ton cranes, special buffers, spring drawbars and towing hooks, which enable tenders to lift, push or tow disabled vehicles and other obstructions. It is of added interest to note that no vehicle has been either too large or too heavy for the tenders to deal with expeditiously.

Staffing—For operating purposes the system is divided into two parts, which are sub-divided into



LINES OF COMMUNICATION

Control, the central exchange, is in instant telephonic communication with all officials on 167 miles of tramway route.

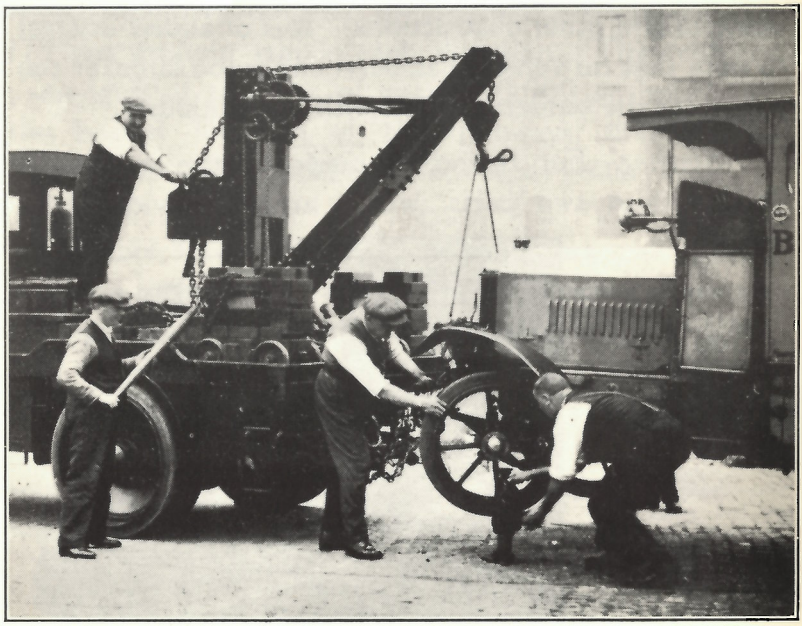
L.N.A. Photos

districts. The road staff comprises eight District Superintendents; 23 District Inspectors; 388 Regulators and Inspectors; 150 Depot Inspectors; 7,028 Motormen and Conductors; and 543 other grades; a total of 8,140.

Hours of duty are an 8-hours day including half-an-hour for signing on and off. By agreement, at least six men out of ten complete their work without a break and no day's work on a car exceeds 8 hours.

Rewards for Suggestions.

The efficiency of traffic and works operatives is promoted in more ways than one. Money awards are made for suggestions that are capable of adoption or,

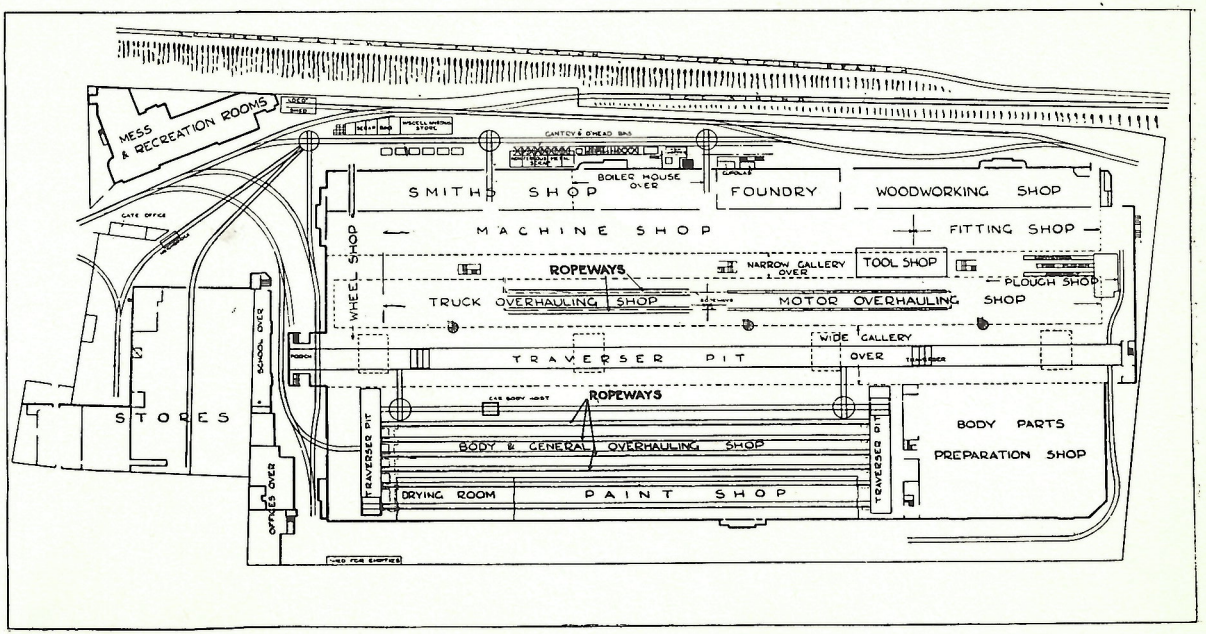


A Breakdown Gang

failing that, indicate more than ordinary interest or initiative. The suggestions are not only numerous but represent every phase of work. Further, there is an annual essay competition for the non-administrative staff, the entrants writing on such subjects as the avoidance of missed fares and the best way to route a certain group of services. At intervals there are depot meetings at which members of the administrative staff and the authors of prize-winning essays read papers, and management and men freely discuss everyday traffic and other problems. The value of cultivating public goodwill is stressed in particular and the meetings (always well-attended and enthusiastic) have been an important aid in raising the efficiency of the platform staff to a still higher level.

PUBLICITY VALUE OF DIRECTION SIGNS

A Silent Salesman outside a busy Railway Terminus



CENTRAL REPAIR DEPOT, CHARLTON

THE ROLLING STOCK WORKSHOP OF SEVEN ACRES

Rolling Stock

REPAIRS AND RENOVATION

While all running repairs of the fleet of 1712 tramcars are carried out in the 17 car depots, all renovation takes place at the Central Repair Depot, Charlton, S.E., where 1,000 workpeople are employed. The depot covers about seven acres and has direct communication with the Southern Railway, a facility that ensures economical delivery of material into the stores and works.

Under Metropolitan Police regulations cars have to be painted annually and completely overhauled every other year. The number of cars passing through the works to meet schedule requirements is about 36 a week, apart from those repaired after road collisions.

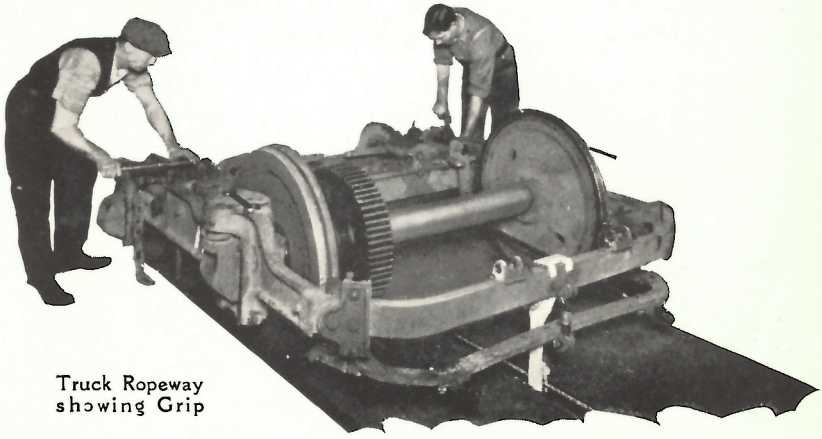
Overhaul of cars is on the progressive system. Four bays, 650 feet long, are equipped with continuously moving ropeways on which trucks, bodies and motors pass through the respective shops. The ropeways travel at a uniform speed, 3 inches per minute, and provide a very flexible method of works production, as output can be regulated by the number of units on the ropeways. Cars requiring extensive body repairs are dealt with on a stationary road.

When a car arrives for complete overhaul, the body is lifted by an electric hoist, the trucks are removed to the truck shop and are replaced by already overhauled trucks fitted with electric motors and ready for

service. The body is lowered on to the overhauled trucks and the car is then connected to the body shop ropeway. As the car travels through the body shop, seat cushions are removed, together with any fittings and furniture needing repair or replacement. Controllers are re-coppered in position unless inspection shows that extensive overhaul is necessary, in which case the unit is replaced. Power and lighting cables are tested and circuit breakers and switches are removed and calibrated on a specially-designed motor generator set.

By this time the car has traversed the body shop and with fittings and furniture re-assembled it enters the paint shop on another ropeway. In the short space of 15 working hours both body and truck are washed down and given one coat of colour and one of varnish and the car is ready for licensing. The trucks are sprayed, at pressure of about 4 lb. per sq. inch, special exhaust apparatus being unnecessary at this pressure.

Meanwhile, on a truck shop ropeway, the motors are removed and the trucks completely dismantled.



Truck Ropeway showing Grip

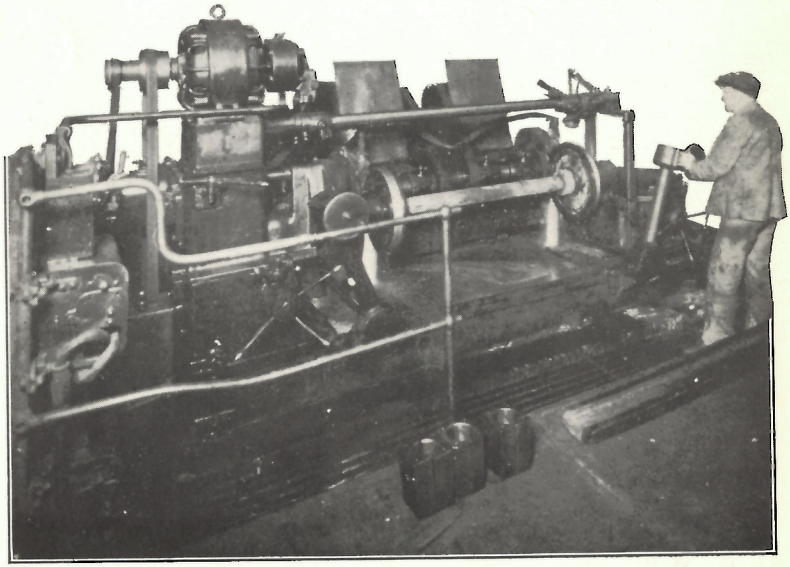
On another ropeway the trucks are re-assembled and equipped with motors, which meanwhile have been overhauled and tested on the motor shop ropeway.

The plough required for use on the conduit system is suspended beneath the car body and makes contact with the conductor tees in the conduit. In the plough shop, 1,000 ploughs per week are re-conditioned on

The Plough Shop: Conveyor Tables

the average. This work is done on three conveyor tables, which progress 20 inches per minute and can be staffed by more operatives if greater output is desired. *See illustration on the previous page.*

Preparation of wheels and axles has undergone radical change. Tyre grinding (*see illustration below*) has eliminated the use of lathes, with the exception of the lathe retained for flange-forming or the turning of wheels very badly flatted. In order that shrinking on of tyres shall not affect the mechanical properties obtained by heat-treatment on the 70-80 ton per sq. inch tensile tyre, use is made of an electrically-controlled gas oven —plant that prevents tyres being raised above safe temperature. *See illustration at top of the next page.*

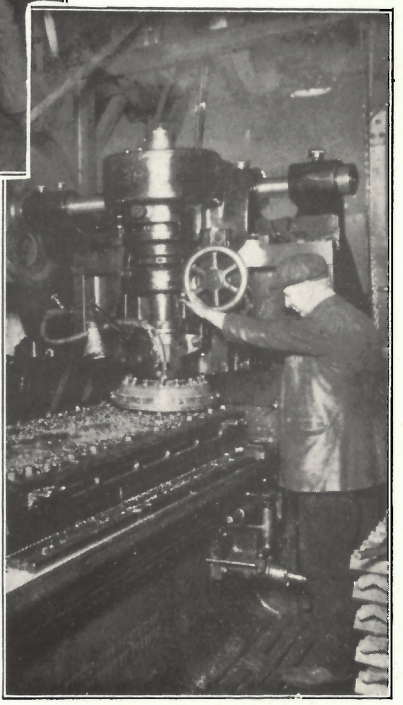


Tyre Grinding

Shrinking Tyres on Centres.

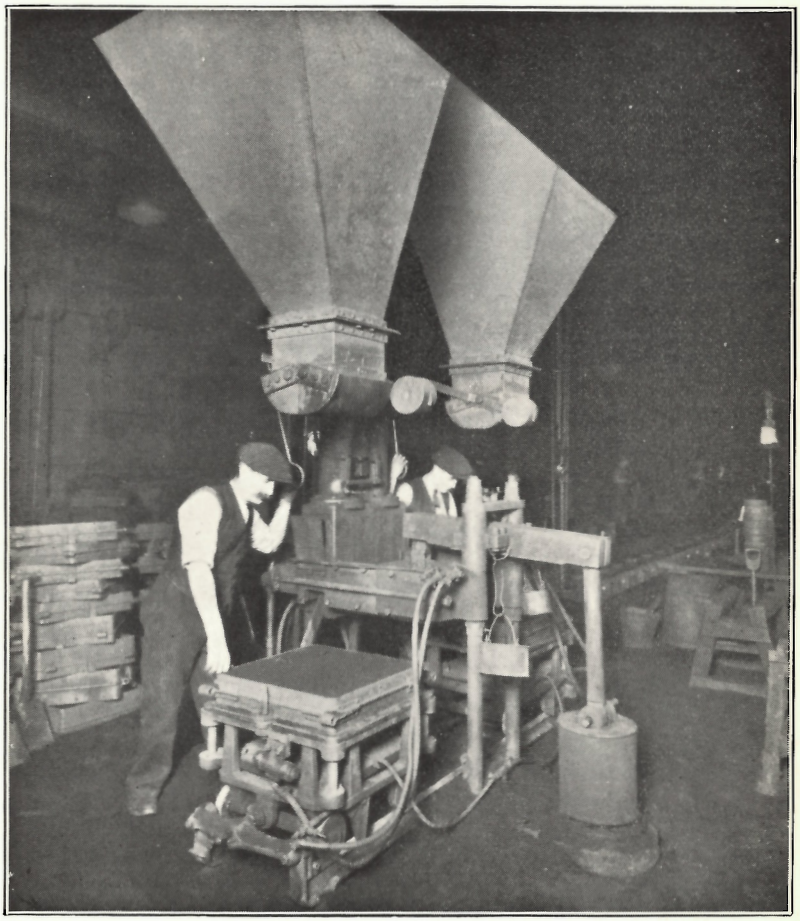
Axles, armature shafts and pinions are subjected to the electro - magnetic method of crack detection.

The machining of magnetic brake shoes is highly specialised. Rolled steel bars are bunched and cut in a modern bar-cutting machine. On the plano milling machine about 44 bars can be set up on the table, the cutter consisting of 16 tools. *See illustration below.* The weekly output of shoes is approximately 2,000. The system of jig drilling is one that makes for easy assembly of the shoe on the magnet.



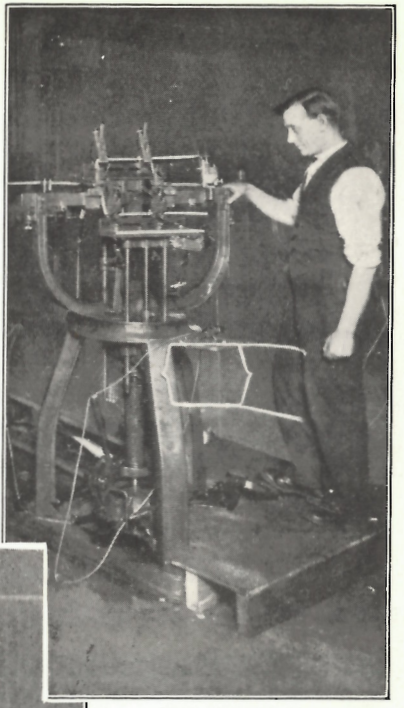
Plano Milling Machine

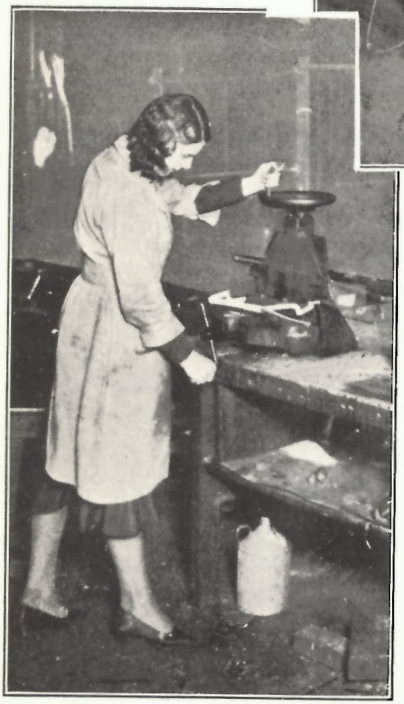
Use of an elevator and conveyors in the foundry has made it possible to have the moulding boxes broken out over a grid and the sand elevated, milled and returned to the storage bins for use. As the bins are right over a duplex pneumatic ramming machine, output is maintained at a very high level. *See illustration below.*



Moulding Machine with Sand Hoppers.

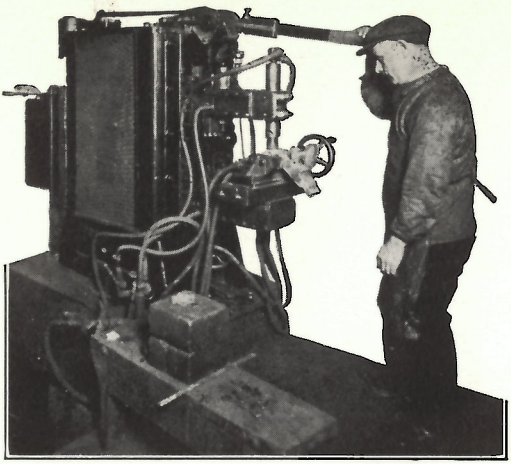
Recently the British Standards Institution Class B insulation for traction motors has been adopted for armature and field coils, magnet coils and controller windings. The windings derive increased life from the higher temperatures permissible with this class of asbestos insulation, compared





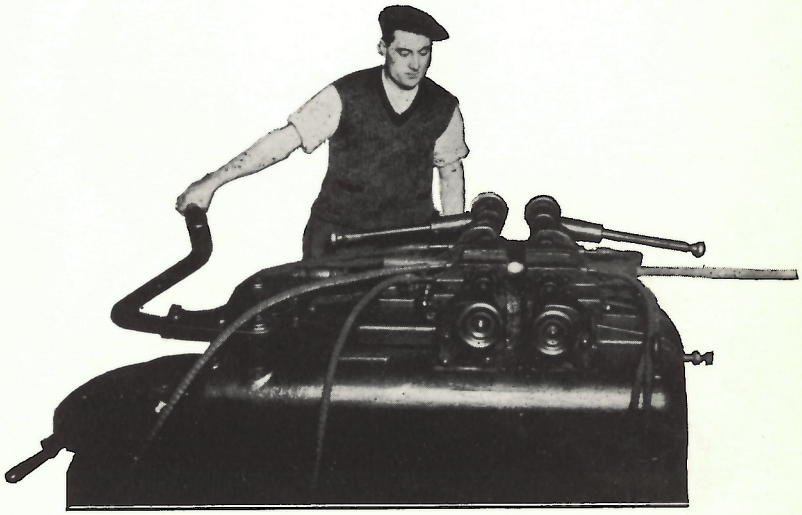
Armature Work

with cotton-covered conductors. The armature coils are machine-wound and passed to women operatives, who form them in hot and cold presses and insulate the coils with mica cloth sheets (*illustrations on this page*). All rewound and repaired armatures are tested in standard frames on a Froude dynamometer.



Vertical Welding Machine

Electric butt welding machines are used for welding brake rod ends, and badly-worn holes in truck parts are filled (ready for re-drilling) in a vertical welding machine. Welding plants of the transformer type are installed for building-up or seam welding.



Horizontal Welding Machine

ROLLING STOCK STORES

The stores system for rolling stock is centralised at the Central Repair Depot, three-fifths of the stores being used there and the remainder in 17 car depots. Eleven sections are allocated to bins and four more comprise the despatch room, receiving room, inspection section and stores office. All the stock books are kept on a priced quantity basis and the records are checked and kept accordingly. Stocktaking is in continuous operation so that an efficient check is always available and at the end of the financial year the whole of the stock is again taken.

Mechanical handling of material is assisted by trucks and runways, and two lifts and an electric hoist deliver stores to the upper floor. The bins are so constructed that individual compartments can be varied.

The Motor Shop of the Central Repair Depot, showing ropeways *See page 11*

The Tramcar of 1932

RECENTLY BUILT AT CENTRAL REPAIR DEPOT

Outwardly the car is distinguished by its blue-and-white finish and stream-line effect. Parts that project on the standard car — such as vestibules, indicator boxes, side destination boards and head lamps—are built into the body.

Folding doors on both platforms give finish to those features and, in addition, make it possible to accommodate standing passengers in comfort at one end of the car, just behind the driver. Large illuminated destination boxes, of rectangular shape, take the place of streamer boards on the sides.

The interior of the car has been planned to provide, in both saloons, maximum seating comfort, electric lighting of the diffused type and tubular electric heaters operated from the line supply and so arranged that sections may be varied to produce the desired temperature.

Seats number 28 in the lower saloon and 38 in the upper saloon. All seats are not only of the armchair type but are in pairs, with reversible backs. The upholstery is blue moquette, with panels of rexine, in both the lower and upper saloons. Soundproof lining on the floor is covered with blue "battleship" linoleum to blend with the blue of the rexine panels and the white stippling of the ceiling.

Full drop windows in the lower saloon provide improved means of ventilation in warm weather, while louvres on the windows are so arranged that the air is changed with the necessary frequency, under all conditions.

The absence of doors and bulkheads in the lower saloon not only enhances the appearance of the car but allows free access to the upper saloon at either end of the car. The platform being of the straight-through type, there is no step up into the lower saloon, while staircases, with easy treads, lead to the upper saloon.

While the car is in service the rear door is open and the front door closed. The latter is in sole control of the driver and is opened at the termini only. Door and step are operated together, by air, and immediately above the step is a concealed lamp.

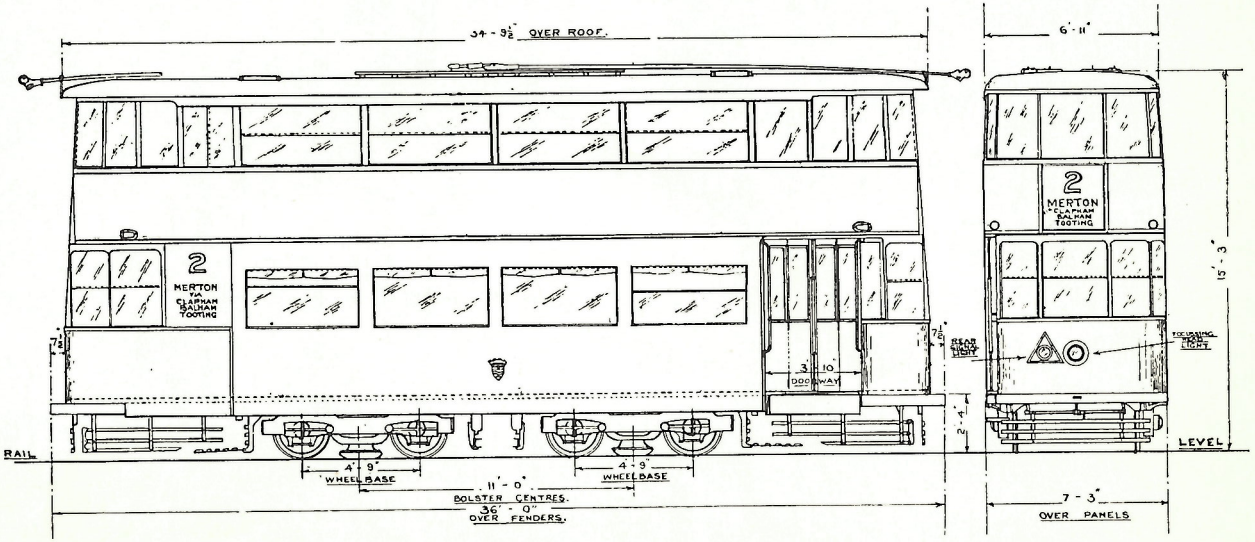
The driver has a vestibule compartment to himself and commands a clear view of traffic, both ahead and following. Driving conditions have been eased by the provision of a driver's seat, air brakes, electrically-operated warning horns and air-operated windscreen wipers and sanding gear—all of them new features. An increased number of signal bells, operated from the line voltage, give passengers and conductor adequate facilities for warning the driver.

A Minimum of Noise

The car has an acceleration of 3.5 ft. per second per second and a maximum speed of 30 miles per hour. It is mounted on a pair of equal-wheeled bogie trucks with 4-motor equipment, the motors driving on the axles through single helical gears, so ground as to afford silent running.

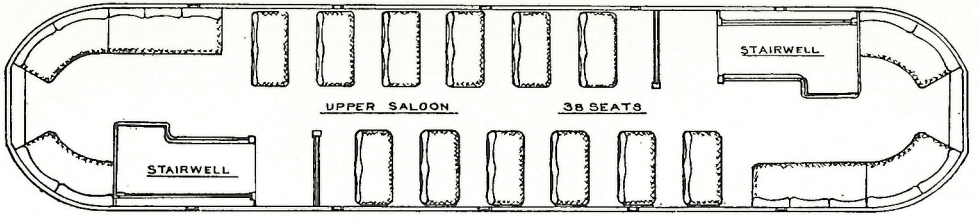
The design of the truck is worthy of note, as noise has been reduced to a minimum. Radial arms have been substituted for the axle-box hornways and transmit the power from the axles to the car, saving the wear that usually occurs between wearing plates on the axle boxes and horn guides. The trucks are fitted with $26\frac{1}{2}$" diameter wheels and the electrical equipment consists of four 35-h.p. motors, two motors permanently in series.

For illustrations see also frontispiece and pp. 20, 21

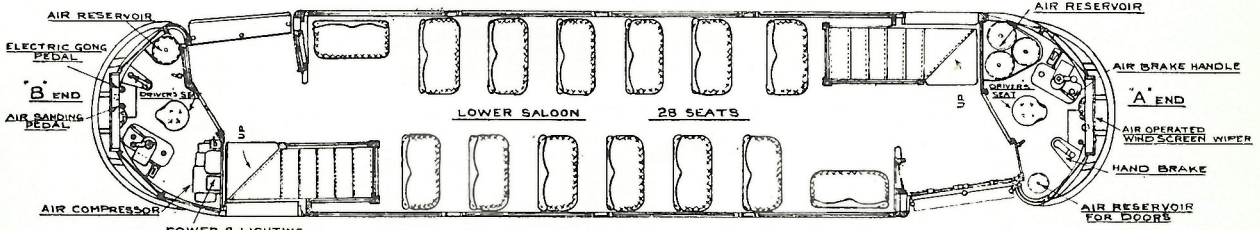


THE TRAMCAR OF 1932: EXTERIOR

For description see pages 18 and 19



PLAN OF UPPER SALOON



PLAN OF LOWER SALOON

THE TRAMCAR OF 1932: INTERIOR

For description see pages 18 and 19

THE SUPPLY AND DIS

INSTALLATION OF NEW

PRACTICALLY all power for L.C.C. Tramways is supplied from the department's power station on the Thames bank at East Greenwich. When the new plant is installed it will have a capacity of 87,000 kw. with an output approaching 250 million units per annum, the whole of it for tramway purposes.

The station stands on $3\frac{3}{4}$ acres with a river frontage on which a pier 200 ft. in length can accommodate coal steamers up to a tonnage of 2,500 tons. Its four chimneys, each 14 ft. in diameter at the top, were designed for a height of 250 ft., but at the Admiralty's request two were built to 182 ft. only, it being thought that at the full height they might interfere with Greenwich Observatory.

The Thames at Greenwich, showin
by four chimneys) and (by the ri

The station buildings consist primarily of a boiler house and turbine house, running parallel; a switch house, circulating water pump house, outside coal bunkers, offices and mess-rooms, while in the yard is a staff recreation room.

The pier is equipped with two Temperley type transporters for the discharge of coal, each of them fitted with a 2-ton grab. Unloaded from the steamers, the coal passes through automatic weighing machines on travelling belts. These convey it at the rate of 200 tons per hour to the bunkers, which comprise an outside

bunker under the pier, with a capacity of 2,000 tons; bunkers for about 12,000 tons above the boilers; and a reserve bunker for about 10,000 tons alongside the main building. The average weekly consumption of fuel is slightly in excess of 4,000 tons, all of it British.

The Boiler House contained, originally, 48 small boiler units, but these are being replaced gradually. Some years ago, three Clayton & Shuttleworth boilers each with an evaporative capacity of 70,000 lbs. per hour were installed, followed by three Clarke Chapman boilers each of 75,000 lbs. Each of these boilers, which are fitted with retort type stokers, delivers steam at a working pressure of 200 lbs. per sq. inch and a temperature of about 520° *F.*

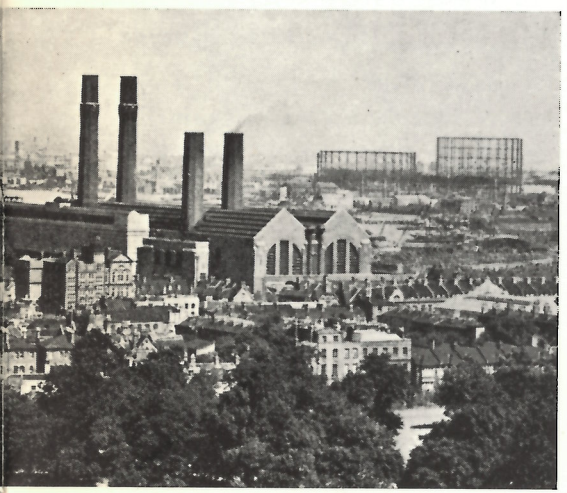


Photo by "The Times"

g the L.C.C. Power Station (marked
er edge) its coal-conveying plant

A further ten boilers by Messrs. Yarrow & Co., Ltd., are being installed. These have a capacity of about 60,000 lbs. per hour and deliver steam at a working pressure of 400 lbs. per sq. inch and a temperature of about 750° *F.* They are being fitted with chain grate stokers of the Underfeed L. type.

Ashes from the boilers are removed by Bennis drag-link conveyors and hydraulic type conveyors.

The Turbine House, when the present stage of reconstuction is completed, will contain two 20,000 kw. British Thomson-

Houston H.P. turbo alternators, one 15,000 kw. Richardson & Westgarth turbo alternator, two 8,000 kw. Metropolitan Vickers, one 8,000 kw. Metropolitan Vickers Parsons and one 8,000 kw. Brown-Boveri turbo alternator.

Water for the condensers is drawn from the Thames through fixed strainers and pumped through rotary strainers to the condensers.

The alternators supply three-phase current at a pressure of 6,600 volts between phases and a frequency of 25 cycles to the main busbars. Each machine is provided with Merz-Price or Merz-Beard protection against internal faults.

British Thomson-Houston and Brown-Boveri voltage regulators are also installed.

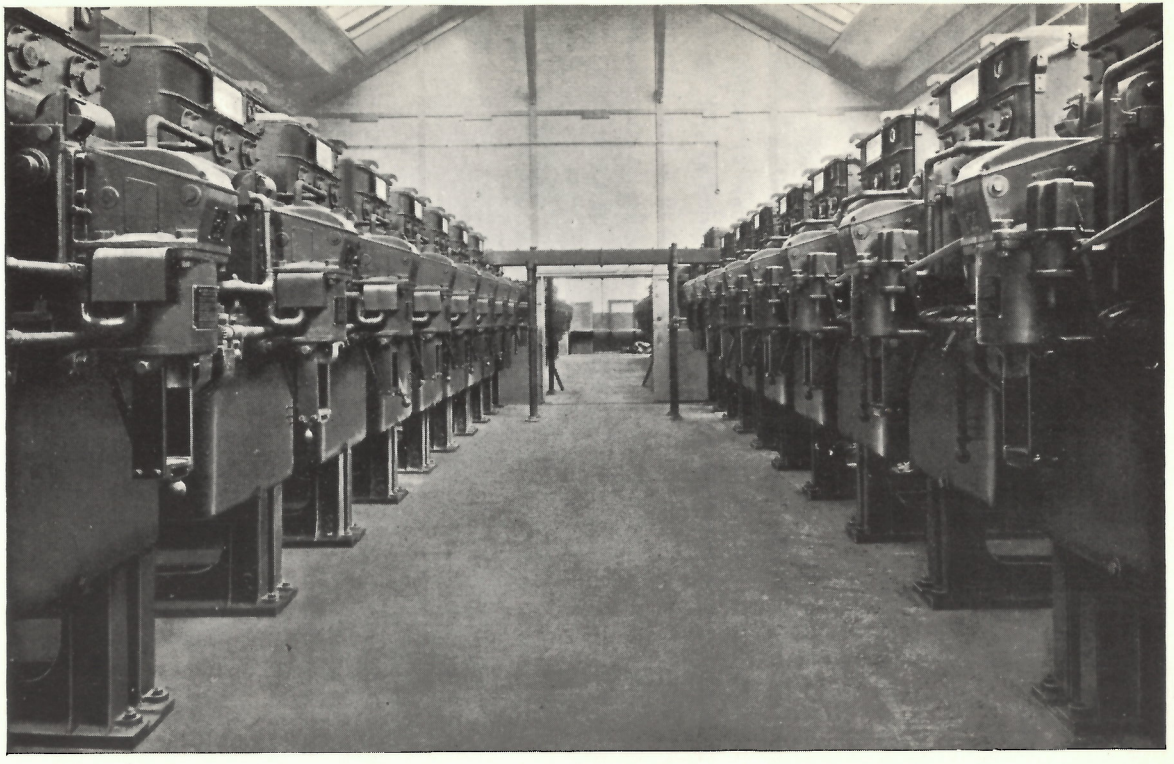
Switchgear and Control Room.—The control room is centrally situated on a gallery on one side of the turbine house, from which it is separated by a glazed screen. The control panels for the alternators and feeders are arranged on three sides of the control room and separate panels on adjacent wings accommodate the feeder meters and relays.

The extra high-tension switchgear, which is housed in a special switch-house behind the control room, consists of English Electric iron-clad compound-filled units with oil circuit-breakers having a rupturing capacity of 500,000 K.V.A.

Power for the station auxiliary AC plant at 220v. is obtained through oil-immersed transformers connected to a section of the main busbars and arranged for the isolation of the auxiliary supply in the event of a severe fault on the system.

A separate transformer room in the boiler house block supplies the necessary AC power for the H.P. boiler house auxiliaries at 400v.

Power for DC auxiliaries and for the local tracks is obtained from a sub-station adjoining the turbine house and there is a 600 amp-hour Tudor secondary battery floating on the DC busbars so as to ensure a supply to the auxiliaries connected thereto.



Part of the English Electric Switchgear in Greenwich Power Station—plant that is typical of recent great developments

Constant frequency for the operation of electric clocks, including those at Holborn and Aldwych stations, is maintained by means of a Warren master frequency controller.

Distribution.—The power from the main generating station is transmitted to 24 sub-stations (in addition to that attached to the power station), which are scattered throughout the system and convert the 6,600 three-phase current to direct current at a pressure of about 600 volts by means of rotary convertors or motor generators.

From the rotary plant current is delivered through watt-hour meters to the main busbars and thence to various sections of tramway track. These sections are about $\frac{1}{2}$ mile in length and, generally each is supplied through separate switches and feeders. In outlying areas, however, two sections are in a few instances supplied by one common pair of feeders, whilst in central areas separate feeders are necessary for each $\frac{1}{2}$ mile of single track.

The sub-station switchgear includes provision for rapidly testing any one section of the track, so that in the event of trouble faults may be located speedily.

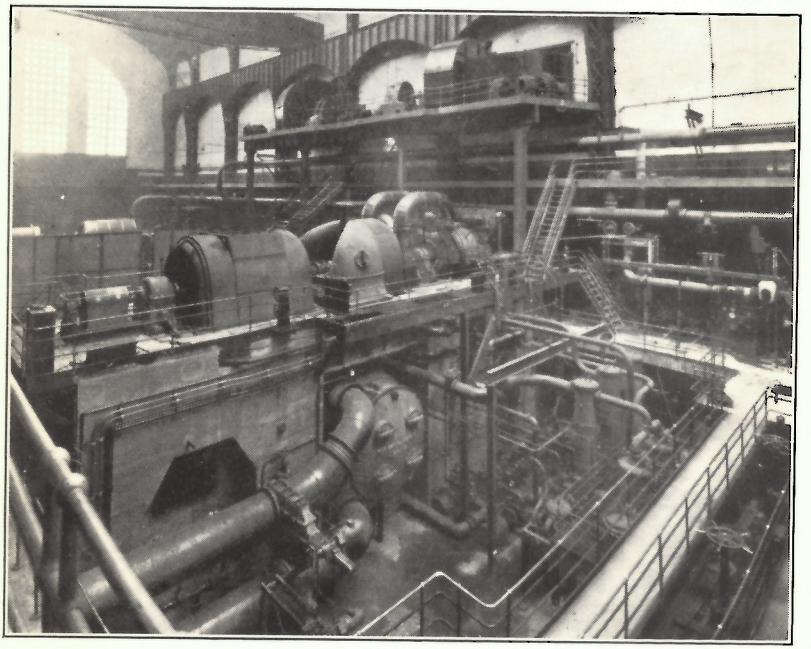
On the conduit portion of the system the negative busbar is earthed at the sub-station, and the conductor rails, both positive and negative, are insulated throughout. As a result it is possible to reverse the supply at the sub-station in the event of an earth developing on either bar. In this way a fault can be put on to the negative side of the system without interfering with the running of the service.

The equipment of the electrical system apart from the power station includes 123 machines in sub-stations, approximately 790 miles of cable, 494 miles of conductor tee rail, 3,140 manholes, 155 miles of duct line, 440 feeder pillars and 3,480 overhead poles.

The switchboards for auxiliaries and local tracks are grouped on either side of the control room.

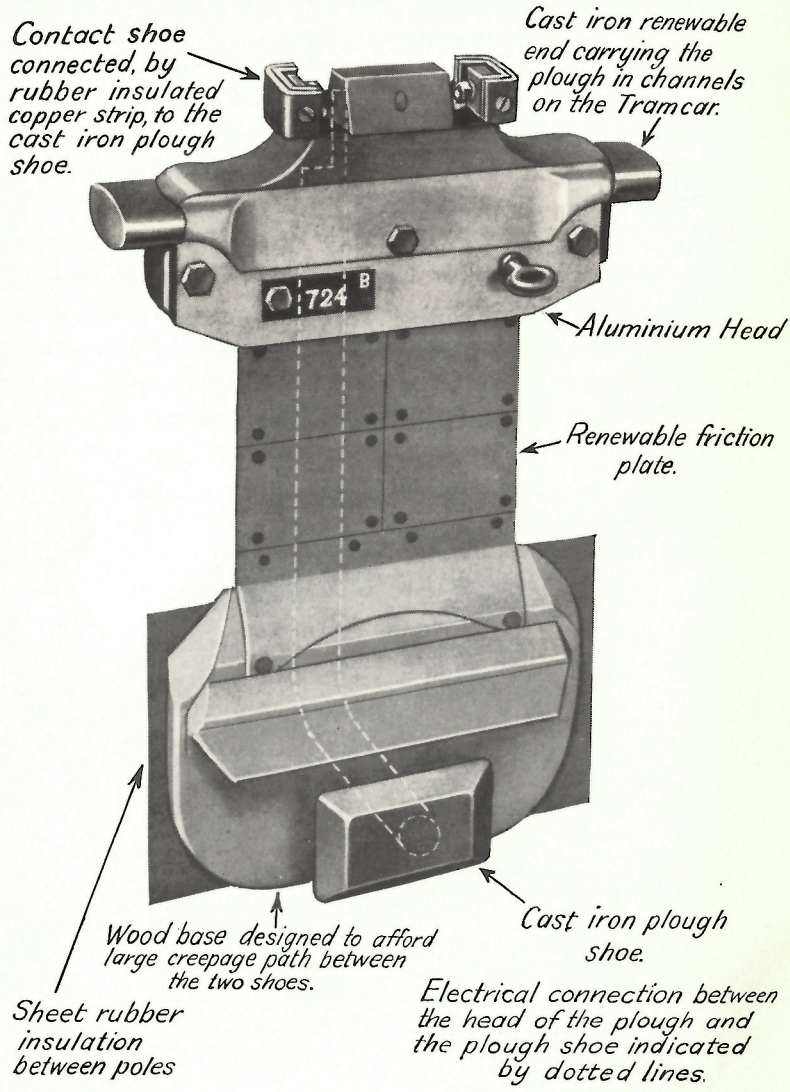
General.—The turbine house is provided with two motor-driven overhead travelling cranes, each capable of handling loads up to 50 tons, and a motor-driven jib crane of 30 tons capacity in the yard adjacent to the boiler-house delivers heavy material from barges.

Arrangements for repair work include a combined machine and fitters' shop fully equipped with machine tools for turbine house and general repairs, a small shop for boiler house repairs, smiths' and carpenters' shops, general stores, tool stores and a chemical laboratory for fuel analysis and other matters.



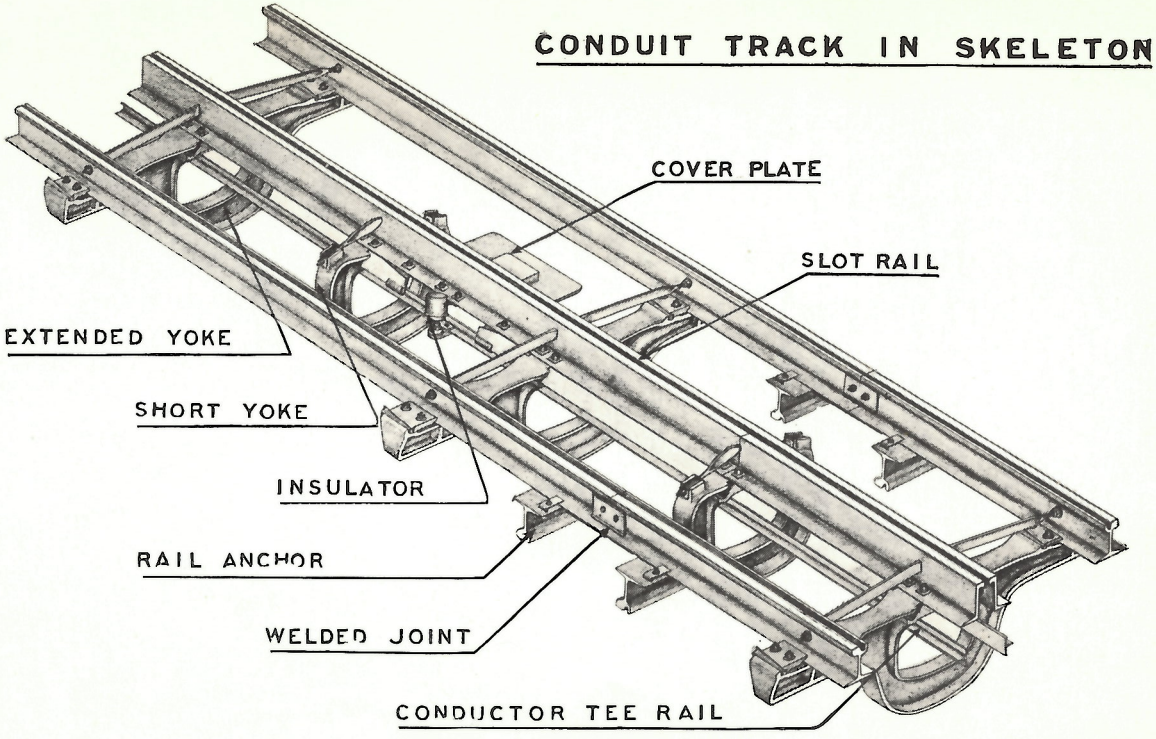
The New Installation: 20,000 kw. Turbo-Alternator (British Thomson-Houston) and Condensing Plant (Hick Hargreaves)

CONDUIT PLOUGH



See also pages 30 and 31

CONDUIT TRACK IN SKELETON



See also pages 30 and 31

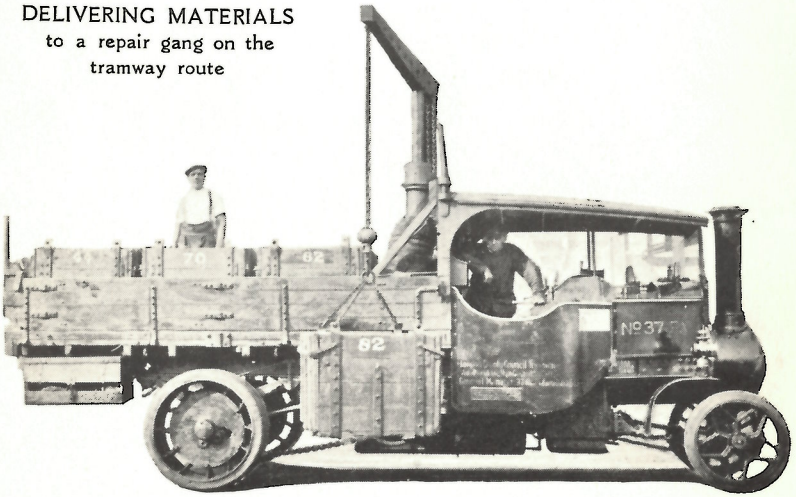
Permanent Way

MAINTENANCE OF 333 MILES OF TRACK

The Permanent Way comprises 333 miles of single track, of which 247 miles are on the conduit system, the only example of its kind in the United Kingdom. The framework of this system consists of cast-iron U-shaped yokes, to which the slot rails are bolted. Alternate yokes have extended arms which act as anchors for the running rails. The foundation concrete extends under the rails and around the yokes in a solid mass to form a tube. *For an explanatory illustration see page 29.*

The electrical conductor consists of two T-shaped rails which are suspended from insulated hangers in the conduit, and current is collected by means of a plough fixed beneath the car (*see illustration on page 28*). For drainage purposes pits connecting

DELIVERING MATERIALS
to a repair gang on the
tramway route

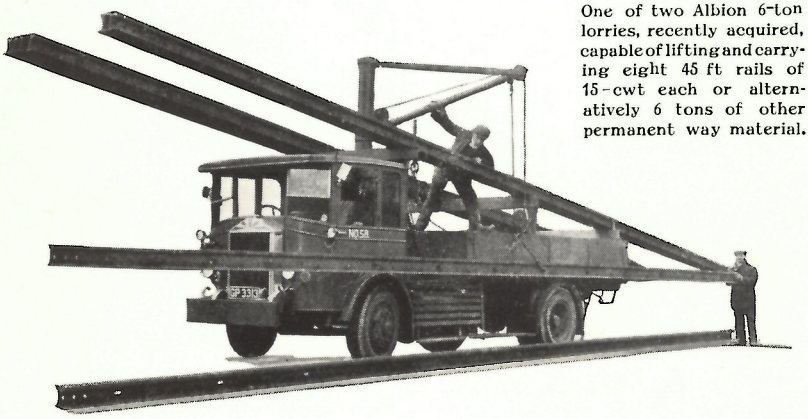


with the sewers are formed in the conduit. For the removal of ploughs in emergency, there are hatchways at junctions, crossovers and other convenient places.

For both conduit and overhead systems, the rails at each joint are securely bolted together by fishplates, which with the addition of a soleplate are seam-welded by the electric arc process.

The overhead system extends for 86 miles of single track in which the foundation generally consists of a bed of concrete 9 inches thick or (if re-inforced) 7 inches thick.

The amount of steel for rails, castings, etc., used annually is about 6,500 tons. The rails and paving of more than 20 miles of single track are renewed annually, the work being done mainly in the summer simultaneously by composite road gangs in each of the eight districts into which the tramway system is divided for maintenance purposes. The method employed is as follows: A breaking-out gang removes paving and prepares the open track for the removal of the old rails. On the following night a plate-laying gang removes old and lays new rails and fastenings. The next day a third gang re-instates the paving, thus ensuring a complete circuit of operations and the renewal of a section of track every two days.



One of two Albion 6-ton lorries, recently acquired, capable of lifting and carrying eight 45 ft rails of 15-cwt each or alternatively 6 tons of other permanent way material.

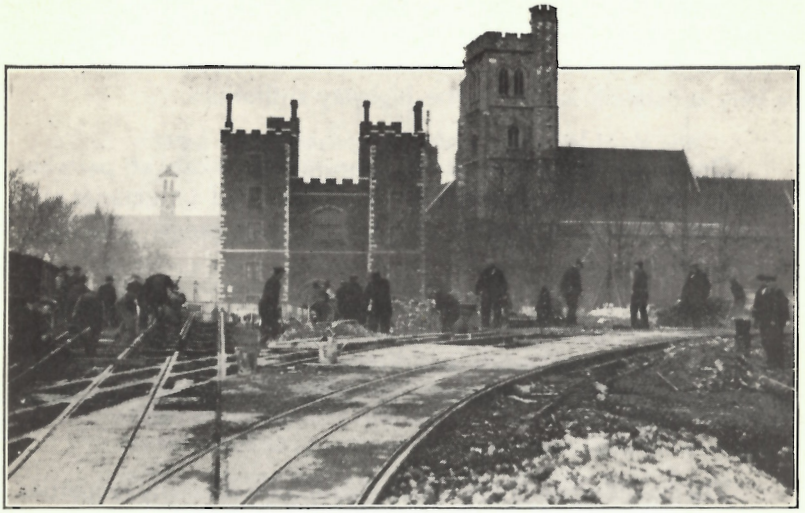
Renewal of rails at stopping places is necessary every six to seven years. Between stopping places the average life is 16 to 17 years.

In the conduit system the maintenance and renewal of special trackwork in junctions and crossings are a task of considerable magnitude and this work is done throughout the year by a specially organised and experienced gang devoted solely to this duty.

The electric arc welding process is used for renovating castings in situ, a process that consists of building up worn parts with deposited metal. Rail corrugations are removed by grinding and the oxy-coal gas flame is employed for the removal of high check on the rails.

Most of the track is paved between the outer rails with granite setts grouted with a bituminous compound, while the marginal paving generally consists of creosoted deal blocks. The width of roadway maintained is generally about $16\frac{1}{2}$ feet.

TYPICAL NIGHT-WORK on the Permanent Way. (*Left*) Machine grinding of rail joints and (*centre and right*) renewing of points, and welding of joints by electric arc process. *Photo by "The Times"*



LAMBETH PALACE supplied historic background for work of relaying tramway track consequent upon the rebuilding of Lambeth Bridge the position of which is on the left of the picture. *Photo by "Evening News*

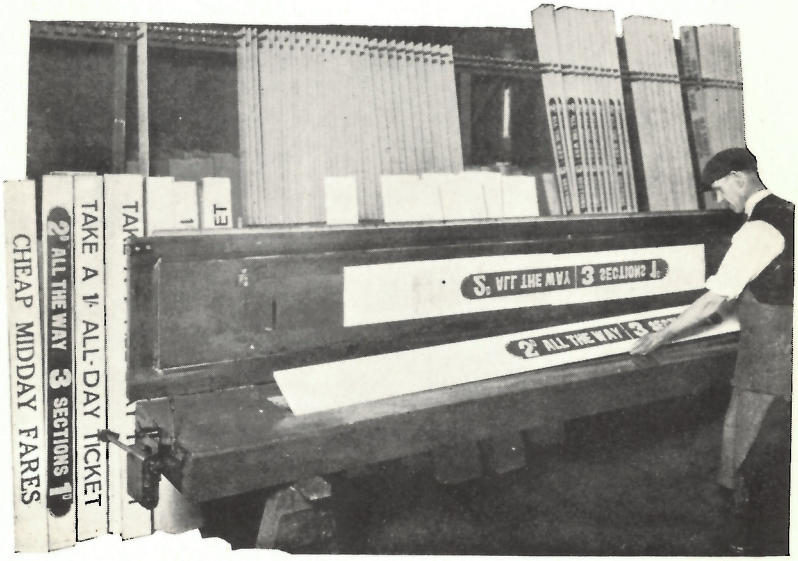
A NETWORK OF TRAMWAY JUNCTIONS in Whitechapel High Street, work that necessitated considerable alterations to service mains of all types, including a 48-inch gas main.

Owing to the present-day density, weight and speed of general vehicular traffic this obligation, a legacy of horse tramcars, constitutes a very serious item of maintenance cost and represents a very substantial saving to the highway authorities.

On repair work a time-saving feature is the use of portable containers, which are transported by lorries fitted with cranes and deposited when and where required by the repair gangs. *See illustration on page 30.*

Three depots situated at Poplar, Deptford and Peckham are used for the storage, repair and distribution of plant and material, the total weight distributed annually amounting to about 62,000 tons.

The maintenance of the building structures for many properties is carried out by direct labour, namely: the generating station, 27 sub-stations, 18 car depots, central repair depot, three permanent way depots and wharves, printing works, Kingsway subway, numerous passenger shelters and the head and local offices.



MAKING DESTINATION SIGNS by modern methods. *(See opposite page)*

Innovations in the Car Depots.

Lettering is painted on destination boards and blinds with the aid of a stencil pasted on silk gauze, a swift operation that calls for no touching-up.

See illustration on page 34

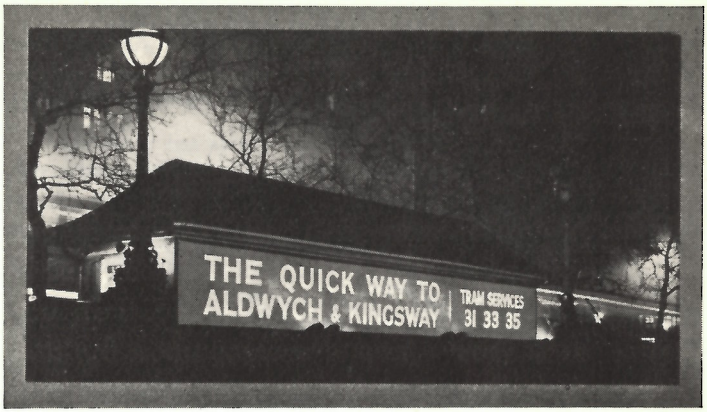
❋ ❋ ❋

Destructors are installed in the car depots for the burning of all car refuse, especially used tickets The system not only ensures satisfactory combustion but is also economical, as it supplies the hot water required for depot work and saves the cost of removing refuse.

CAR WASHING UP-TO-DATE

Daily cleaning of tramcar exteriors is performed with high-pressure guns that discharge water at pressure of up to 300 lb. to the square inch.

The cars are soap-washed regularly and cushion seats are vacuum-cleaned twice a week.



A flood-lit painted sign on Westminster Bridge waiting-room

KINGSWAY SUBWAY

Kingsway tramway subway, which admitted only single-deck tramcars (seating 36 passengers) until it was deepened in 1930, is served by full-sized Pullman tramcars of 74 seats. Although seating accommodation is more than doubled, the service is the same as before reconstruction, namely, 30 tramcars an hour in each direction.

With its three services Kingsway provides direct communication between both sides of the Thames, north to Highgate and Manor House, east to Hackney, south to Wandsworth, Norwood and Forest Hill.

Kingsway tramcars make 6,800 journeys and carry 250,000 passengers a week through this traffic artery. Below the road surface, reached by short staircases at four points along Kingsway, tramcars come and go every minute from 5 a.m. until past midnight. Traffic jams being impossible, the journey from Southampton Row to Charing Cross is made in 6 minutes.

From the street to the tramcars is a matter of a few seconds' walk, and bright, new stations have safe and spacious platforms, the paving and columns of which are formed of marble and stone mosaic in soft colours.

There is an abundance of concealed lighting, which floods the station without shadow or dazzle. It is supplemented by emergency lights, concerning which the Inspecting Officer of the Ministry of Transport said that these lights alone illuminated the platforms more brightly than was the case at many railway stations. "Models of cheerfulness, brightness and comfort" is a description of the stations, bestowed by a Minister of Transport.

A Tramway Station in Kingway Subway

TRAINING SCHOOL FOR MOTORMEN

The Training School for Motormen at Clapham Depot contains a skeleton tramcar on which rheostats, motors, cables, etc., are exposed to view. In order that the motors may operate without movement of the car its wheels are arranged to revolve on rollers.

Armatures, field coils, circuit breakers, track magnets, ploughs, a feeder pillar with telephone box and other equipment are exhibited in order that the function of each may be explained, and in addition there is a full-size model of the conduit.

A battery of controllers and hand brakes, with gong and sand pedals, face a series of electric signs, which indicate occurrences requiring instant action by learners operating the controllers. Any one sign may be illuminated by the instructor, who sees that learners make proper response.

Training is designed to combine practical experience on the road with the simple technical knowledge gained in the motor school.

Training extends over four weeks, in the last fortnight of which the learner operates a service car on various routes in charge of a selected motorman. The motor school superintendent and the instructors periodically visit depots, when all motormen are encouraged to discuss any difficulties they may have met and to refresh their knowledge on technical points.

A Driving Lesson in the Motor School

In the year 1931, 776 motormen qualified for the awards of the Safety First Council for freedom from accident. These successes were 70 per cent. more numerous than in 1930. Fourteen years without accident was the record of one motorman, and twelve years that of another.

Replenishing Supplies of Tickets —

A Scene at a Conveyor Table

THE CONVEYOR SYSTEM OF TICKET CHECKING

The principal feature of interest in the ticket checking section is that the work of replenishing supplies of tickets in 3,000 conductors' boxes and entering tickets on the waybills is done on moving conveyor tables about 140 ft. in length and traveling at approximately 13 ft. per minute. Behind the tables are racks with movable trays accommodating tickets of various denominations, arranged in the order appearing on the waybills. The trays have a capacity of 6,000 tickets each, 20 millions in all. From time to time the trays are removed and replenished with supplies from raised benches behind them.

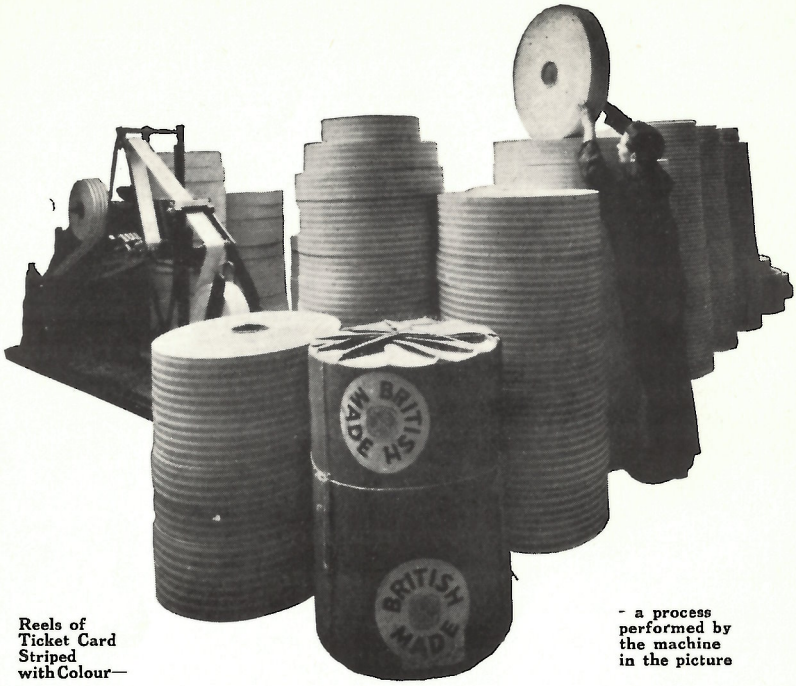
The first operation in the conveyor room consists of emptying the conductor's ticket box and placing the unsold tickets in a

convenient order on the conveyor table, together with the punch, a blank waybill and a "filling" card indicating the number of tickets required for each duty. As the boxes, waybills etc., pass down the table, assistants seated in front of each denomination of tickets enter the unsold tickets on the waybills and also record the quantity required to make up a day's supply, which they take from the racks. *See illustration on page 40.*

The punches are also checked and cleared on the conveyor table, but if the punch register does not agree with the waybill the punch is withdrawn for investigation and another is put in the box. The completed boxes are then conveyed by the moving tables and escalators back to the loading platform, where they are placed in wooden containers, which motor lorries deliver during the night to depots in various parts of London.

Other operations—the cross-checking of entries on the new waybill with the bill for the previous day, counting (if necessary) punch clippings, preparing cash returns, etc.—are carried out on stationary tables. The arithmetical correctness of the waybills for the previous day is checked with the aid of comptometers.

HOW SEVEN MILLION TICKETS LOOK— WHEN STACKED



Reels of Ticket Card Striped with Colour—

– a process performed by the machine in the picture

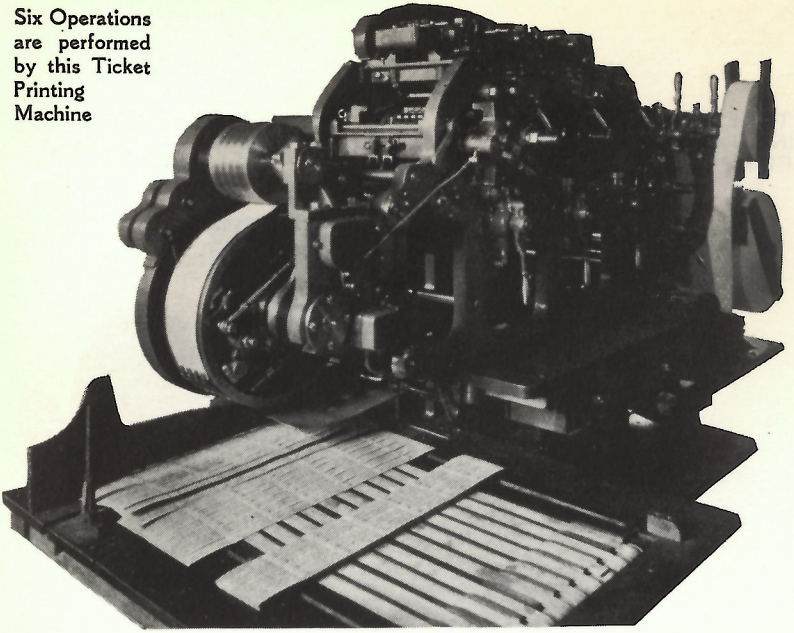
PRODUCING TWO MILLION TICKETS A DAY

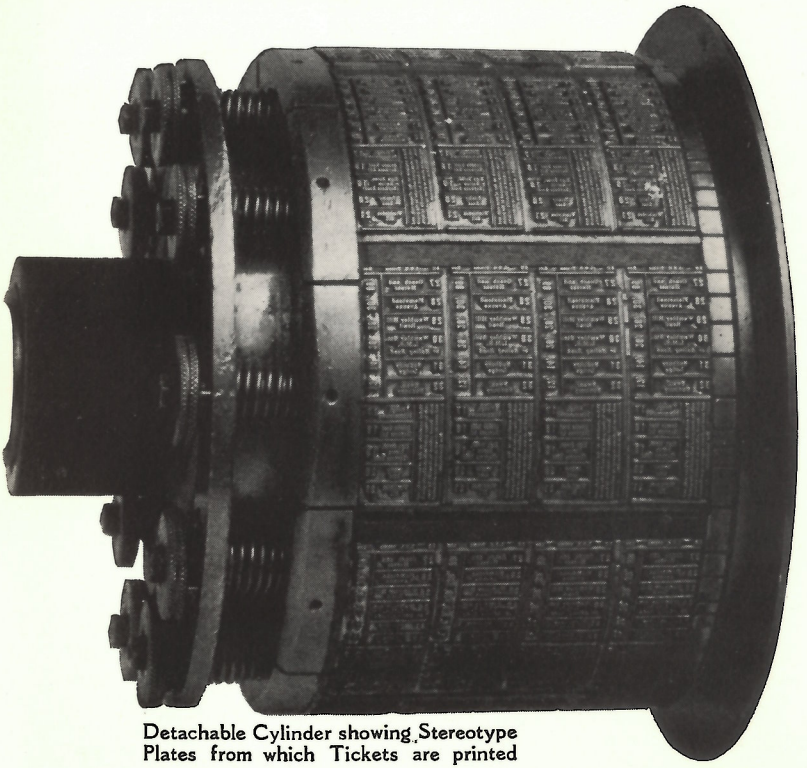
The card for L.C.C. Tramways tickets arrives from an English factory in the form of white rolls, each $\frac{3}{4}$ mile long and sufficient for 450,000 tickets.

The rolls are slit into reels like the one being handled by the operative in the above picture and the reels are dyed with stripes of colour on the machine shown in the same illustration.

The printing takes place on a rotary machine illustrated on the next page—a machine that prints all the detail on both sides of the ticket, overprints the value in a second colour, numbers the tickets consecutively, scores the card for easy division into strips and cuts it into lengths.

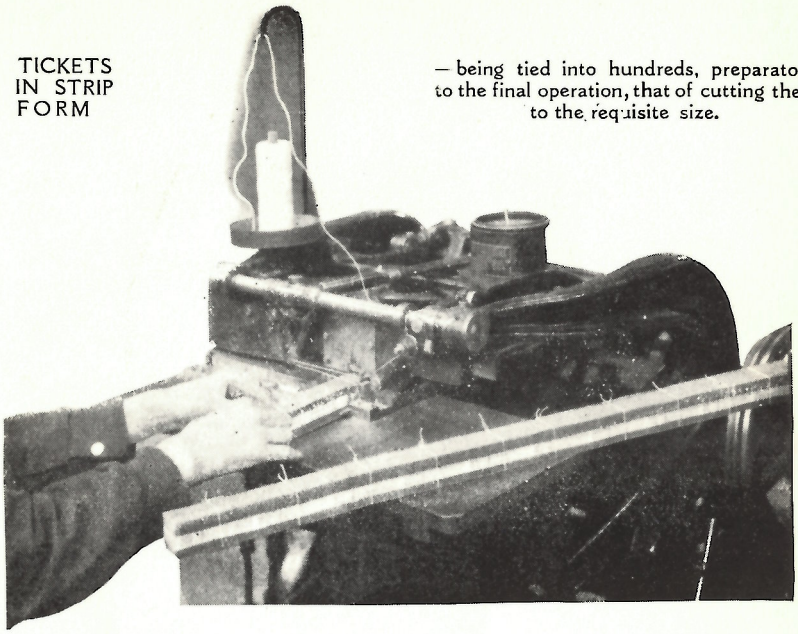
Six Operations are performed by this Ticket Printing Machine





Detachable Cylinder showing Stereotype Plates from which Tickets are printed

TICKETS IN STRIP FORM



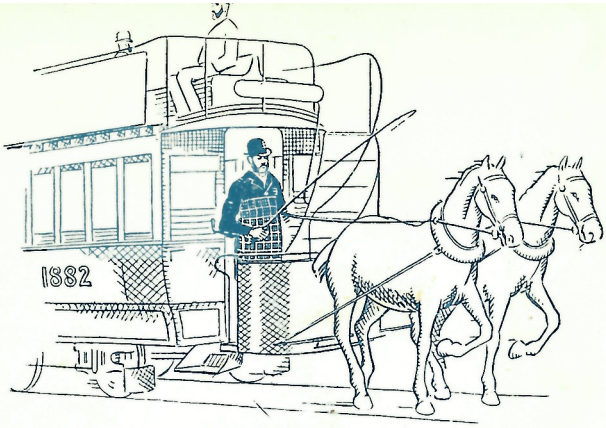
— being tied into hundreds, preparatory to the final operation, that of cutting them to the requisite size.

On another machine the lengths are stapled at the rate of 8,000 tickets per minute and the next machine ties the tickets (now in strip form) at the rate of 5,300 a minute (*See illustration above*). From here the tickets go to the guillotine, there to be cut into the familiar rectangles, 1,000 at a time.

A day's output of tickets is two millions and weighs about a ton. Placed end to end the annual output would stretch 33,820 miles.

One method of publicity is the exhibition of posters in colour, a specimen of which is reproduced on the page opposite. Other publications for attracting traffic are newspaper advertisements, letterpress posters and pamphlets, wall maps, pocket maps, timetables and games fixture cards.


LONDON'S TRAMWAYS
"Hush-a-bye baby"
THE ZOO
SERVICES TO CAMDEN TOWN
NORTH LONDON 5·19·27·29·53
SOUTH LONDON Via KINGSWAY



L.C.C. MILESTONES.

1903
First electric tramways opened by H.M. King George V. (then Prince of Wales).

1906
Tramway along Victoria Embankment opened.

1910
Most horse traction had been converted to electric.

1922
Trailer tramcars abandoned.

1926
First Pullman tramcar put into service.

1930
Single saloon (subway) tramcars abolished.

1931

Every Tram a Pullman.
A fleet of 1712, of which 312 were new in the last two years.
As illustrated opposite

Recently Constructed
A stream-lined and faster Pullman with armchair seats and enclosed staircases.

Published by
L.C.C. Tramways,
23, Belvedere Road,
London, S.E.1